Sectoral and occupational employment growth in Spain. 1995-2005

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Abstract (English)

Between 1995 and 2005, the Spanish economy grew at an annual average rate higher than 3,5%. Total employment increased by more than 4.9 millions. Most of this growth was in occupations related with university degrees (more than 890,000, 18% of the total employment increase) and vocational qualifications (more than 855,000, 17.5% of the total employment increase). From a sectoral perspective, the main part of this increase took place in "Real estate, renting and business activities" (K sector in NACE rev.1), "Construction" (F sector) and "Health and social sector" (N sector). This paper analyses this employment growth in an Input-output framework, by means of a structural decomposition analysis (SDA). Two kinds of results have been obtained. From a sectoral perspective we decompose employment growth into Labour requirements change, technical change and demand change. From an occupational perspective, we decompose the employment growth in substitutions effect, labour productivity effect and demand effect. The results show that, in aggregated terms, the main part of this growth is attributable to demand growth, with a small technical improvement. But the results also show that this aggregated behaviour hides important sectoral and occupational variation. The purpose of this paper is to contribute to the ongoing debate over productivity growth and what has been called the "growth model" for the Spanish economy.

Keywords: Employment growth, structural decomposition analysis

JEL Codes: O41, O47, C67.

Resumen (español)

Entre 1995 y 2005, la economía española creció a una tasa anual media superior al 3,5%. Durante este periodo el empleo total aumentó más de 4,9 millones. La mayor parte de este crecimiento tuvo lugar en ocupaciones relacionadas con titulaciones universitarias (más de 890.000 empleos, el 18% del total) y ocupaciones relacionadas con titulaciones de formación profesional (más de 850.000 empleos, el 17,5% del total). Desde una perspectiva sectorial, la mayor parte de este crecimiento tuvo lugar en los sectores "Actividades inmobiliarias y de alquiler, servicios empresariales" (sector K, CNAE rev.1), "Construcción" (F) y "Actividades sanitarias y veterinarias, servicios sociales" (N). Este trabajo analiza este proceso de creación de empleo con la metodología de las tablas Input-Output, utilizando modelos de descomposición estructural. En la perspectiva sectorial, descomponemos la variación del empleo en tres componentes; la variación de los requerimientos unitarios de trabajo, el cambio técnico y la variación de la demanda agregada. Desde la perspectiva ocupacional, descomponemos la variación del empleo en un efecto substitución, un efecto relacionado con la variación de la productividad del trabajo y otro relacionado con la variación de la demanda final. Los resultados muestran que en términos agregados, el crecimiento de la demanda agregada es el componente principal, pero también amagan comportamientos diferentes entre industrias y ocupaciones. El objetivo del trabajo es contribuir al debate actual sobre el crecimiento de la productividad y el llamado "modelo de crecimiento" en la economía española.

Palabras clave: Crecimiento del empleo, análisis descomposición estructural

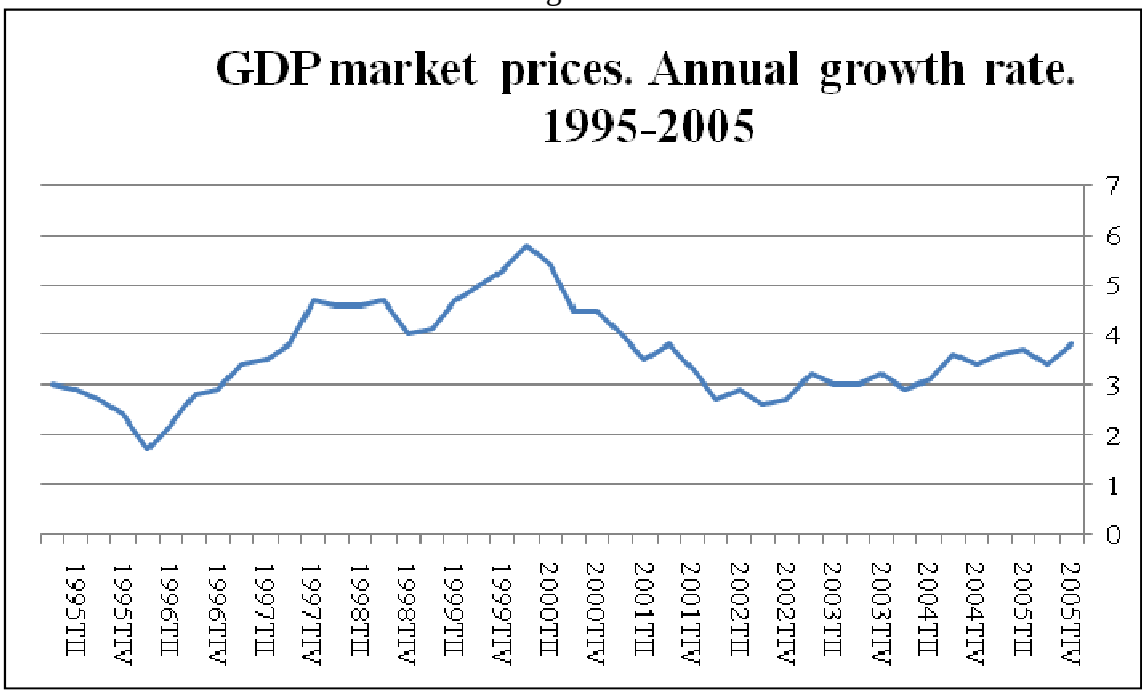
Códigos JEL: O41, O47, C67.

1. Introduction.

The Spanish economy is in the media nowadays because of the depth of the crisis. Since 2008, more than 4 million jobs have been lost. The GDP has shrunk by more than 6% and the prospects are not very optimistic. But during the period 1995-2007, many people in Europe were speaking about the "Spanish miracle". Average GDP growth between 1995 and 2005 was higher than 3.5% (figure 1); more than 4.9 million jobs were created (figure 2); total employment peaked at almost 20 million[1]; the unemployment rate reached a minimum of 8% at the end of 2007; the public debt to GDP ratio was under 36% in 2007, one of the lowest in the UE; and the public budget showed a surplus in 2005, 2006 and 2007.

[1] Along the period there have been changes in active population definition that have changed the unemployment figures and the rate.

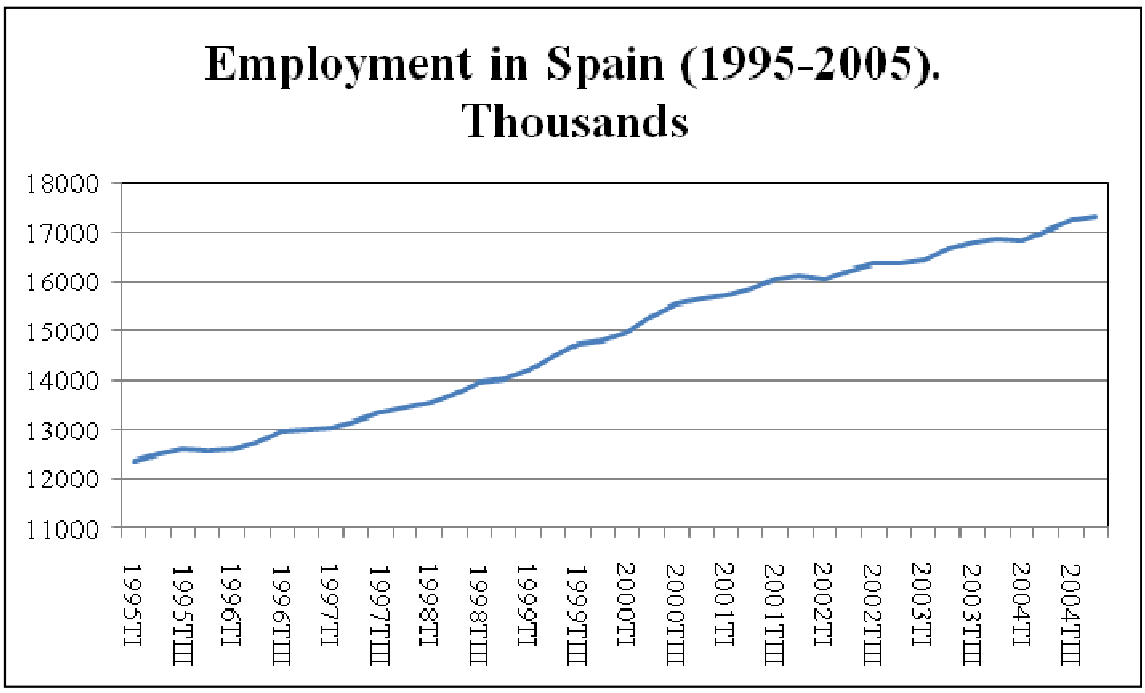
Figure1



Source: INE. (National Statistics Institute)

Despite these figures, the growth path was weak and very dependent on external factors: large demand for construction, speculative growth of property prices and easy access to credit in international markets. Moreover, there was a progressive growth in the balance of payments deficit, a continuous deindustrialization process and the growing international trade deficit which reached 10% of GDP, the second largest in the world. The main purpose of this study is to analyse this period (1995-2005) focusing on employment growth and occupational change.

Figure 2



Source: INE. EPA (Labour force survey)

The distribution of employment among sectors and occupations changes over time as a result of the interaction of economic and social or institutional processes. Within these processes, the evolution of production techniques, changes in final demand and institutions of the labour market play a significant role. In regards to the first issue, two questions deserve attention: the process innovations tend to reduce material inputs needs and also labour force needs per unit of output. In this sense they tend to increase unemployment in the short term. But product innovations generate a compensatory effect that tends to increase employment in the medium and long run. If process innovations reduce production costs and these reductions are transferred to prices, they change final demand both in terms of overall amount and distribution. The discussions on the whole effect of this structural change are as old as classical political economy. This paper sheds some light in this debate analysing the issue for the Spanish economy in a long and important growth cycle.

One of the most extended views of this period of the Spanish economy is that this important growth was not accompanied by similar growth in productivity. But more than 18% of the employment growth took place in occupations related with university degrees; another 18% of total growth was in occupations related with vocational education. All in all, more than 38% (around 1.7 million) of these new jobs were held by very qualified workers. How can it be that this stage was not accompanied by productivity growth if almost half of the new jobs were held by highly qualified and educated persons?

At first sight, it seems to be contradictory that an economy that creates almost 5 million jobs, with more than 1.7 million corresponding to educated and qualified workers has not experienced productivity growth. In our opinion in order to understand

this puzzle, a disaggregated view is needed. The input-output framework seems the best suited theoretical standpoint from which to analyse the issue. It allows assessing the differences in employment change among sectors.

Several articles have analyzed this period of the Spanish economy. But as far as we are aware only one has used input-output methods: De Juan and López (2004) apply a SDA to the occupational employment change for the period 1980-2000. By other side, although some of them have used a disaggregated perspective, none of them have gone further than a standard four-sector view. What is more relevant, they have used "aggregated production functions" as a benchmark. So this study, which uses an input-output perspective, has to be seen as an alternative, as it uses multi-sector production function and a more disaggregated view.

Jimeno (2007) analyses the factors behind unemployment reduction from 2000 to 2006, considering changes in employment composition, the impact of immigration flows, the general context of productivity slowdown and the institutional framework. He shows that despite the increase in the active population, the increase in female labour activity and the huge arrival of immigrants, the Spanish economy was able to create jobs and to reduce its unemployment rate. Focusing on the occupational structure of employment the study shows that between 2000 and 2006 the greatest increase have been in technical occupations, and in qualified and unqualified occupations in the service sector. By sectors, the industries that have undergone increased employment are "Construction", "Real state and renting, business services", while "Industry" and "Agriculture" show a clear reduction.

Using data from the Groningen Growth and Development Centre, the study shows a clear productivity slowdown for the period 1996-2006. Although the Spanish productivity growth was in line with that of Germany and France since the 1970's, the aforementioned data show a clear slowdown since 1995. The author points to different causes: the employment increase in industries with low capital intensity and low productivity, the scarce technological innovation of Spanish firms and problems with the quality and the allocation of human capital.

Andrés *et al.* (2010) analyse Spain's economic evolution to assess the need to change the "growth model" or to reform the labour market institutions. They use an aggregated production function to obtain estimations of Okun's Law and use this framework to defend the need for both changes. They use the standard four-level aggregation. In this sense, Villaverde and Maza (2009) estimate the Okun coefficients for the seventeen Spanish regions for the period 1980-2007. Their results report that Okun's Law holds for all regions as well as for the whole country, that there exists great variation in the Okun coefficients and that this variability is linked to regional differences in productivity growth.

García Serrano (2011) analyses the change in sectoral employment since 1999 to 2007 comparing this with the EU-17 and EU-27 countries with Eurostat data, showing that Spain is the country where employment has grown most. But the analysis only considers a four sectors break-down. He also compares the weight of construction in total employment and shows that it is the highest in EU. Furthermore, he also analyses

the occupational employment change arguing that employment growth was larger in those occupations related with the construction sector.

The main purpose of this study is to analyse the employment and occupational growth during 1995-2005 by means of a Structural Decomposition Analysis (SDA). As is well known, SDA allows breaking down the change in one variable related with total output (in this case, employment by sector and employment by occupation) in the proportion caused by different variables[2]. With this aim, we have collected and prepared two set of data. Firstly we have used symmetrical input-output tables for the Spanish economy for 1995, 2000 and 2005. We have aggregated sectors to match them with employment data. Secondly we have constructed three sets of employment distribution for the same years, these showing the employment figures for the same sectors as the input-output tables and also the occupational composition of employment for each sector.

Two kinds of SDA models have been developed: the first one takes into account sectoral employment growth. The results show which part of employment growth is due to changes in unitary labour requirements (labour worth by unit of output in each sector), to technical change (changes in Leontief inverse matrix) and to final demand shifts. The second application analyses occupational change: in this case the results show the proportions of occupational growth due to substitution effect (change in the occupational composition of employment in each sector), labour productivity effect (change in direct plus indirect labour productivity by industry), and final demand shifts.

Several studies have been developed for other countries and periods using SDA frameworks. The seminal and one of the most quoted is Skolka (1989) who analysed economic growth and employment, relating its variation with changes in technology, domestic final demand, foreign trade and labour productivity. Han (1995) focuses on the employment shifts due to changes in technology and final demand in Japan in the period 1975-85. Lee and Schluter (1999) examine the effects of international trade on skilled and unskilled employment for all sectors in US economy for period 1972-92. Leclair (2002) analyses the effect of export composition on manufacturing employment for 1985-95. Wolff (2006) analyses the growth in information workers in the US economy in the period 1950-2000, assessing the role of technological change, computerization and structural change.

The main contributions of this paper are the use of input-output framework and the disaggregated perspective. The first has to be considered as an alternative to the use of aggregated production functions. The second allows us to go further in the analysis of the behaviour of employment.

The structure of this paper is as follows: in the second section the data and the tools that have been used are presented. The third section sets out the two models that decompose the employment growth by factor. The fourth section presents and analyses

[2] A general overview of SDA techniques and several examples can be found in Blair and Miller (2009). A critical review of the SDA methodology is offered by Rose and Casler (1996) and an analysis of the problems caused by the existence of multiple forms in Dietzenbacher and Los (1998).

the results. And the concluding section reflects on employment variation in Spain in light of the results.

2. Data

The INE (National statistics Institute) webpage contains symmetrical Input-Output tables for the Spanish economy for 1995, 2000 and 2005. The original tables are presented with a break-down of 71, 73 and 73 sectors, respectively, at current prices. The change in the number of sectors is due to changes in NACE classification. Four main arrangements have been made:

- Aggregation: adding rows and columns we reduce the dimensions of the I-O tables to adapt them to the disaggregation level of employment figures. The symmetrical tables used have a 14-sectoral disaggregation. Annex 1 shows the sectoral disaggregation level which corresponds to the first level (alphabetical) of NACE rev. 1.1 (2002)[3].

- As the data is in monetary units, and we do not have a price index for the sectoral production we have used the evolution of the CPI to measure all flows in 2005 €.

- We have subtracted total imports that are in a row and consider them jointly with exports to express, in the final demand, the trade balance for each sector.

- P Sector (Activities of households) does not have any flow in the symmetrical I-O table. Moreover, we do not have information about employment so we have removed this sector. L Sector (Public administration and defence; compulsory social security) only presents flows in the corresponding column, but not on the row. We have separated public services purchases from all sectors and added them to public spending in the final demand column. Furthermore, we do not have information on the public employment occupational structure.

In regards to employment we have obtained from the INE website a data set that contains the number of employed people[4] by occupation and sectors. The aggregation level of sectors matches with technical data from I-O tables. The occupations are disaggregated at the first numerical level of CNO, which correspond to ISCO 88 international classification. The data is presented by quarters. To avoid or limit seasonal variation, we have used annual averages. Unfortunately, the data are only available until the fourth quarter of 2004. Since first quarter of 2005 the Labour Force Survey has changed and the INE does not publish this information[5]. Further corrections were made in order to have complete coverage for all sectors. We do not consider armed forces and

[3] It also shows the abbreviations used along the paper.
[4] The employed people figures include wage-earners and self-employed. There is not data about these two categories.
[5] In this sense, the employment data set is unique. Unfortunately it will not be possible to continue the study or to extend it for a longer period. Furthermore, is not possible to further disaggregate occupations or sectors.

we have taken together "Skilled agricultural and fishery workers" and "Craft and related trades workers", creating a level named "skilled workers". This procedure implies finally using an 8-level disaggregation. Annex 1 contains the occupational structure that has been used[6]. Tables 1 and 2 present, for 1995, 2000 and 2004, sectoral and occupational employment, respectively. The tables also present the percentage growth rate (GR %) for sub-periods 1995-2000 and 2000-05 and for the whole period and the composition (% total) for each year.

Table 1. Sectoral employment. (thousands)

Sectors	1995	2000	2005	GR(%) 00-95	GR(%) 05-00	GR(%) 05-95	% total 95	% total 00	% total 05
A	1.037,15	964,63	937,58	-6,99%	-2,80%	-9,60%	9,14%	6,84%	5,77%
B	69,38	64,13	51,38	-7,57%	-19,88%	-25,95%	0,61%	0,45%	0,32%
C	68,88	65,93	59,60	-4,28%	-9,59%	-13,47%	0,61%	0,47%	0,37%
D	2.407,40	2.918,45	3.047,65	21,23%	4,43%	26,60%	21,21%	20,70%	18,75%
E	98,93	98,05	103,73	-0,88%	5,79%	4,85%	0,87%	0,70%	0,64%
F	1.193,80	1.722,70	2.253,23	44,30%	30,80%	88,74%	10,52%	12,22%	13,86%
G	2.096,63	2.512,03	2.817,55	19,81%	12,16%	34,39%	18,47%	17,81%	17,34%
H	787,95	1.003,58	1.200,53	27,37%	19,62%	52,36%	6,94%	7,12%	7,39%
I	757,78	929,93	1.067,20	22,72%	14,76%	40,83%	6,68%	6,59%	6,57%
J	330,45	411,58	401,03	24,55%	-2,56%	21,36%	2,91%	2,92%	2,47%
K	689,48	1.135,50	1.545,53	64,69%	36,11%	124,16%	6,07%	8,05%	9,51%
M	698,90	841,20	1.009,45	20,36%	20,00%	44,43%	6,16%	5,97%	6,21%
N	646,88	830,40	1.029,43	28,37%	23,97%	59,14%	5,70%	5,89%	6,33%
O	467,33	603,85	728,03	29,21%	20,56%	55,79%	4,12%	4,28%	4,48%
Total	11.350,90	14.101,93	16.251,88	24,24%	15,25%	43,18%	100,00%	100,00%	100,00%

Source: INE. EPA (Labour force survey) and own calculations.

Table 2. Occupational employment. (thousands)

Occupation	1995	2000	2005	GR(%) 00-95	GR(%) 05-00	GR(%) 05-95	% total 95	% total 00	% total 05
1	1.018,90	1.191,23	1.300,63	16,91%	9,18%	27,65%	8,98%	8,45%	8,00%
2	1.196,43	1.655,53	2.082,83	38,37%	25,81%	74,09%	10,54%	11,74%	12,82%
3	825,70	1.329,28	1.681,65	60,99%	26,51%	103,66%	7,27%	9,43%	10,35%
4	1.063,85	1.316,88	1.373,03	23,78%	4,26%	29,06%	9,37%	9,34%	8,45%
5	1.536,88	1.945,93	2.364,18	26,62%	21,49%	53,83%	13,54%	13,80%	14,55%
6	2.940,55	3.287,95	3.610,50	11,81%	9,81%	22,78%	25,91%	23,32%	22,22%
7	1.361,78	1.602,10	1.705,73	17,65%	6,47%	25,26%	12,00%	11,36%	10,50%
8	1.407,10	1.773,03	2.133,40	26,01%	20,33%	51,62%	12,40%	12,57%	13,13%
total	11.351,18	14.101,90	16.251,93	24,24%	15,25%	43,18%	100,00%	100,00%	100,00%

Source: INE. EPA (Labour force survey) and own calculations.

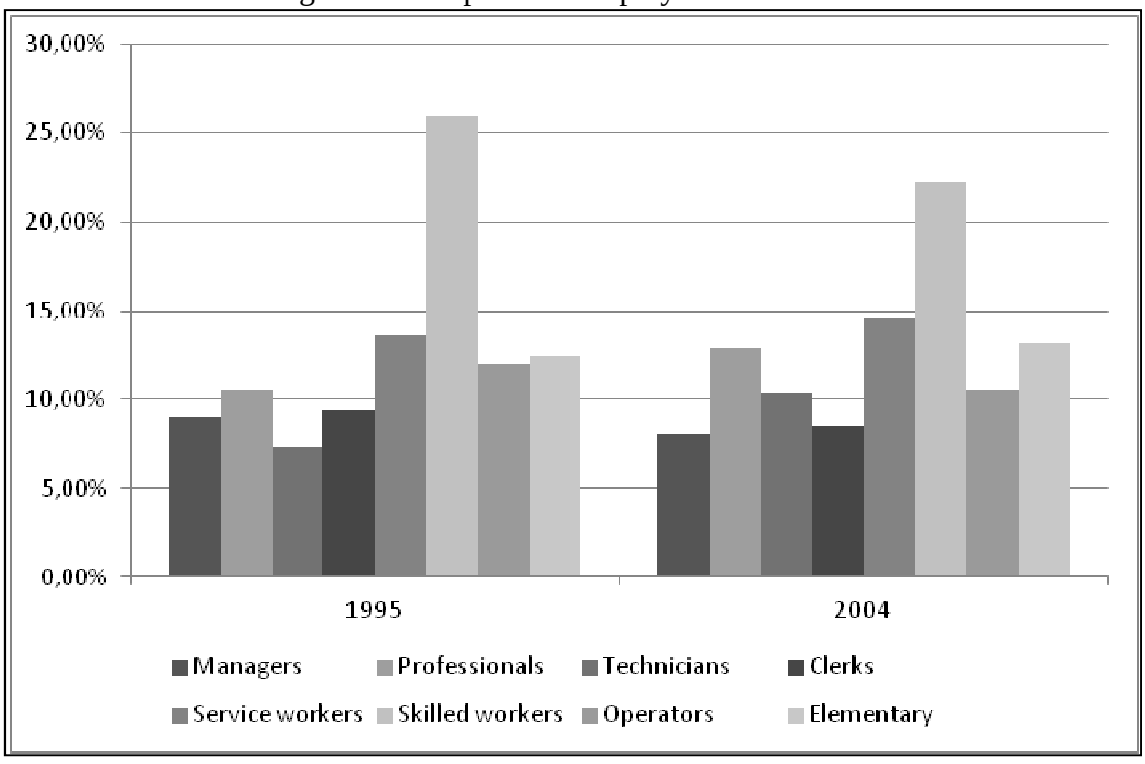
Table 1 shows that total employment for the selected sectors has grown, for the whole period, 4.9 millions. Only three sectors have reduced employment: "Agriculture, hunting and forestry" (A), "Fishing" (B) and "Mining and quarrying" (C). As these sectors are small in terms of total employment, this reduction is small: jointly

[6] It also presents the abbreviations used along the paper.

employment lost is only 126.800. Employment has grown for all other sectors. Sectoral employment growth rates range from 4.85% in "Electricity" (E) to 124.16% in "Real state" (K). In regards to total variation, the most important growth has been in "Real state" (K) and "Construction" (F) with 1.060.000 and 856,000 new employments, respectively. Notice that the behaviour of employment is steady for both sub-periods for all sectors but "Electricity" that decreased in the first sub-period and "Finance" (J) that decreased in the second sub-period. Notice also that sectoral employment structure presents only slight changes: the secular lost of employment in the primary sectors, a continuous reduction in manufacturing employment, growth in service sectors and the peculiar increase in sectors related with Construction and Real State, sectors that undergo a demand boost.

Table 2 shows that the most important increase in employment has taken place in "Professionals" (2) and "Technicians" (3), with outstanding growth rates, 74% and 103% respectively, higher than average employment growth rates. All occupations have grown for the whole period, but the smaller growth rates have been in "Skilled" (6) with 22% and "Operators" (7) with 25%, both well below the average. This difference in growth path has changed occupational structure: in ten years, workers with university degrees ("Professionals") and vocational qualifications ("Technicians") became 23% of the labour force, increasing more than 5 percentage points. The same 5 percentage points were lost by "Skilled" (6) and "Operators" (7). At the same time, "Elementary occupations" (8) grew more than 726.000, a 51% growth rate, higher than the average. Notice that, all in all, the occupational structure has increased employment in qualified categories and in elementary occupations and has reduced employment in skilled workers and operators.

Figure 3. Occupational Employment Structure



Source: INE. EPA (Labour force survey) and own calculations.

With these data sets we have constructed the next matrices. **X** is a 14 x 1 column vector showing total output by sector. **Y** is a 14 x 1 column vector showing final demand by sector. **A** is a 14 x 14 inter-industry input-output coefficients where $a_{i,j}$ indicates the amount of input *i* required per unit of output *j*. Operating as it is standard we have obtained the Leontief inverse matrix: $\mathbf{L} = (I - A)^{-1}$. Each element $l_{i,j}$ shows total input requirements per unit of final demand by sector. **E** is the 8 x 14 employment matrix: the $e_{i,j}$ element shows total employment in occupation *i* in sector *j*. Adding columns we get a row vector **h** (1 x 14); total employment by sector ($h_j = \sum_i e_{i,j}$). Adding rows we get a column vector **b** (8 x 1); total employment by occupation ($b_i = \sum_j e_{i,j}$).

F matrix is an employment coefficients matrix (8 x 14) showing employment by occupation by unit of output; each element is $f_{i,j} = e_{i,j}/x_j$. **C** is a (8 x 14) matrix showing the distribution of employment among occupations within each sector: $c_{i,j}=e_{i,j}/h_j$. Finally, $\boldsymbol{\mu}$ is a row vector (1 x 14) of labour unitary coefficients which contains total employment per unit of output for each industry; $\boldsymbol{\mu}_j = h_j/x_j$.

3. Models.

The development of our models begins by considering the open Leontief model that expresses total output as the product of final demand by the Leontief inverse matrix:

$$X=\left(I-A\right)^{-1}Y \tag{1}$$

Where X is the total output vector (14 x 1), Y is the final demand vector (14 x 1), A is the technical matrix (14 x 14) that contains inter-industry input-output flows and I is the identity matrix. Calling the Leontief inverse matrix L we have:

$$X=L\,Y \tag{2}$$

The first model we develop relates output with sectoral employment. We can relate sectoral employment with output by means of $\boldsymbol{\mu}$ vector. Converting this vector in a diagonal matrix, $\hat{\boldsymbol{\mu}}$ with the coefficients in the principal diagonal and zeros otherwise, total employment by industry may be expressed as:

$$h'=\hat{\mu}\,L\,Y \tag{3}$$

Equation 3 states that total employment by industry (14 x 1) is the product of final demand vector by Leontief inverse matrix by Labour unitary requirements by sector. The apostrophe stands for transposed vector. We apply a structural decomposition analysis:

$$\Delta h=\Delta\hat{\mu}\,L\,Y+\hat{\mu}\,\Delta L\,Y+\hat{\mu}\,L\,\Delta Y \tag{4}$$

Equation 4 states that sectoral employment variation can be broken down into three parts: the first term is the change in Labour requirements by unit of output. It is the reciprocal of direct labour productivity; employment worth by unit of output by sector. We term it “Labour requirement”. The second part is the variation in Leontief inverse matrix. It reflects changes in production techniques, in the organization of production, and the incorporation of new processes and products. We refer to this

second term as “Technical change effect”. The third part is the change in final demand, termed “Demand effect”.

The second model relates output with occupational employment. Occupational employment can be obtained using C matrix:

$$b = C\,\hat{\mu}\,L\,Y \tag{5}$$

But the product μ^L is the reciprocal of total labour productivity, which includes direct and indirect labour per unit of output. Defining Ψ = μ^L equation (5) can be rewritten as:

$$b = C\,\Psi\,Y \tag{6}$$

Applying Structural Decomposition analysis, we have:

$$\Delta b = \Delta C\,\Psi\,Y + C\,\Delta\Psi\,Y + C\,\Psi\,\Delta Y \tag{7}$$

Equation (7) states that the change in occupational employment can be broken down into three parts. The first is the change in the occupational composition of sectoral employment. Technical and organizational change may imply that the occupational mix of each sector has changed. We call it “Substitution effect”. The second is the variation in the reciprocal of total labour productivity, that is, direct plus indirect, in each sector. It is related with technical change, organizational change, and also with the differences in productivity growth path of industries. We present it as “Productivity effect”. The third term shows the change in final demand, termed “Demand effect”.

Dietzenbacher and Los (1998) have analysed the SDA non-uniqueness problem. They stated that with n determinants there exist n! equivalent decomposition forms and that there is not a selection criterion based on theoretical grounds. They also show the variability of the results and then the doubts that the method may arise. They suggest using two polar decompositions and their average and applying mid-points weights as have been predominantly done in literature. The advantage is that the first method is exact although it does not exhibit a simple weighting structure. The second is not exact but when the number of determinants is low it is almost exact. They also suggest presenting the range or the standard deviation of the results obtained with different methods. Moreover, they show that the variability is not affected by the number of sectors. Following these suggestions and the work by Wolff (2006) we use these two methods for equations (4) and (7). For equation (4) we have calculated an approximate decomposition that uses mid-points as weights as follows:

$$\Delta h = 1/4\,(\Delta\hat{\mu})(L_0 + L_1)(Y_0 + Y_1) +$$

$$1/4\,(\hat{\mu}_0 + \hat{\mu}_1)(\Delta L)(Y_0 + Y_1) +$$

$$1/4\,(\hat{\mu}_0 + \hat{\mu}_1)(L_0 + L_1)(\Delta Y) \tag{8}$$

The results are shown in table 3. Table 4 shows the results for the average of the two polar decompositions:

$$\Delta h = \Delta\hat{\mu}\, L_1 Y_1 + \hat{\mu}_0 \Delta L Y_1 + \hat{\mu}_0 L_0 \Delta Y \quad (9)$$

$$\Delta h = \Delta\hat{\mu}\, L_0 Y_0 + \hat{\mu}_1 \Delta L Y_0 + \hat{\mu}_1 L_1 \Delta Y \quad (10)$$

For equation (7) we have operated in the same way: first we have calculated an approximated decomposition with mid-points as weights:

$$\Delta h = 1/4\ (\Delta C)(\Psi_0 + \Psi_1)(Y_0 + Y_1) +$$

$$1/4\ (C_0 + C_1)(\Delta\Psi)(Y_0 + Y_1) +$$

$$1/4\ (C_0 + C_1)(\Psi_0 + \Psi_1)(\Delta Y) \quad (11)$$

The results are shown in table 5. We have also calculated the average of the two polar exact decompositions:

$$\Delta b = \Delta C\, \Psi_1 Y_1 + C_0 \Delta\Psi Y_1 + C_0 \Psi_0 \Delta Y \quad (12)$$

$$\Delta b = \Delta C\, \Psi_0 Y_0 + C_1 \Delta\Psi Y_0 + C_1 \Psi_1 \Delta Y \quad (13)$$

The results are shown in table 6.

4. Results.

Table 3 presents the SDA results applied to sectoral employment change using mid-points as weights. For each effect, the table shows total employment change, and the percentage of total estimated variation. Last column shows actual total change.

Table 3. Industrial employment change. 2005-1995. Mid-points.

	Labour requirement		Technical change effect		Demand effect		Total Change
A	-82,08	81,15%	-293,10	289,76%	274,03	-270,91%	-99,60
B	-16,53	88,50%	-33,68	180,35%	31,54	-168,85%	-18,03
C	-10,56	136,46%	133,41	-1724,12%	-130,59	1687,66%	-9,28
D	-242,07	-37,76%	198,12	30,90%	685,08	106,86%	640,18
E	-47,40	-880,11%	22,87	424,61%	29,92	555,50%	4,70
F	-542,62	-50,17%	472,50	43,68%	1.151,79	106,48%	1.059,48
G	-448,35	-62,04%	151,04	20,90%	1.019,97	141,14%	720,93
H	78,58	19,04%	-20,60	-4,99%	354,74	85,95%	412,50
I	-309,05	-98,10%	216,95	68,87%	407,13	129,24%	309,40
J	-45,34	-69,91%	-204,10	-314,66%	314,30	484,57%	70,55
K	102,45	11,99%	214,33	25,08%	537,84	62,93%	856,00
M	5,13	1,65%	27,46	8,84%	278,05	89,51%	310,65
N	-18,49	-4,83%	30,73	8,03%	370,38	96,80%	382,55
O	-169,00	-64,37%	75,81	28,87%	355,76	135,49%	260,68
total	-1.745,34	-35,43%	991,72	20,13%	5.679,93	115,30%	4.900,70

Source: Own calculations.

The last row shows total employment growth. As it can be seen Demand effect (the increase in final demand) has been the most important factor behind employment growth. *Ceteris paribus* it would have created almost 5.7 million jobs that represent up to 16% more than actual growth. Furthermore, technical change would have appended almost 1 million additional jobs. It is necessary to bear in mind that we have termed "technical change" to the change in Leontief matrix coefficients, what is a mixture of different processes: the improvement of technical or organizational existing production processes and the creation of new products with new processes. It is also affected by changes in relative prices. Notice that the reduction in labour unitary requirement has reduced total employment by more than 1.7 millions. It represents more than 35% of total employment growth. This effect is related to direct labour productivity; the increase in direct labour productivity reduced employment needs by more than 35%.

Table 4 presents the results for sectoral employment change when the average of the two polar decompositions is used. Following Dietzenbacher and Los (1998) suggestion, the range of variation (in absolute values) for each effect is also presented. Referring to total employment change (last row), it can be appreciated that variations attributed to each effect are roughly the same as in the former method. There is only less than 2% difference in the estimated labour requirement effect.

Table 4. Industrial employment change. 2005-1995. Average Polar decompositions.

	Labour requirement		Range	Technical change effect		Range	Demand effect		Range
A	-80,51	80,85%	1,56	-294,68	295,93%	-101,26	275,61	-276,78%	99,70
B	-15,88	88,08%	0,57	-34,33	190,49%	-18,77	32,19	-178,57%	18,20
C	-12,10	130,42%	-0,53	134,95	-1454,96%	57,79	-132,13	1424,54%	-57,26
D	-243,02	-37,96%	-78,13	199,07	31,10%	60,33	684,13	106,87%	17,80
E	-48,09	-1023,10%	-23,66	23,55	501,15%	16,37	29,23	621,95%	7,29
F	-564,82	-53,31%	-496,54	494,69	46,69%	434,83	1.129,60	106,62%	61,71
G	-450,08	-62,43%	-210,01	152,77	21,19%	65,67	1.018,24	141,24%	144,35
H	78,36	19,00%	26,51	-20,38	-4,94%	-9,60	354,52	85,94%	-16,91
I	-314,68	-101,71%	-203,83	222,57	71,94%	139,77	401,50	129,77%	64,06
J	-39,66	-56,21%	-11,85	-209,78	-297,36%	-233,52	319,99	453,57%	245,37
K	103,83	12,13%	71,01	212,95	24,88%	38,31	539,22	62,99%	-109,33
M	5,14	1,66%	1,84	27,44	8,83%	8,81	278,07	89,51%	-10,65
N	-18,56	-4,85%	-8,86	30,80	8,05%	13,30	370,31	96,80%	-4,45
O	-170,89	-65,56%	-117,61	77,70	29,81%	48,38	353,87	135,75%	69,22
otal	-1.770,93	-36,14%	-1049,54	1.017,31	20,76%	520,43	5.654,35	115,38%	529,11

Source: Own calculations.

Focusing on sectoral behaviour, the differences among both methods are small too. The most of the estimated effects vary by less than 3%. There only exist important differences in the labour requirement effect on sector E, on the technical change effect on sectors C, E and J, and on the demand effect on sectors C and E. But C and E sectors are relatively small in employment; 0.37% and 0.64% of total employment in 2005.

The aforementioned average behaviour hides important sectoral variation. In regards to labour requirements, 8 sectors out of 14 have experienced increases in direct labour productivity that has reduced employment. For all these sectors (Manufacturing (D), Electricity (E), Construction (F), Trade (G), Transport (I), Finance (J) and Social services(O)) except Health (N), the labour requirement effect have reduced employment

more than the average. These 8 sectors represent more than 70% of total employment in 2005. The three first sectors (Agriculture (A), Fishing (B) and Mining (C)) have also undergone increases in direct labour productivity. The Labour requirement effect has reduced employment by roughly 80%, 88% and 130%, respectively. As these sectors have reduced total employment, the labour requirement has contributed to this reduction. Only three sectors have undergone increases in employment due to Labour requirements effect. These sectors, Hotels (H), Real estate (K) and Education (M) are typical service sectors, labour intensive sectors where innovation and mechanization are very difficult.

Focusing on Technical change effect, 10 sectors out of 14 have experienced employment growth. For 8 of them the percentage increases are larger than the average. Only 4 sectors have reduced employment due to technical change: Agriculture (A), Fishing (B), Hotels (H) and Finance (J).

Demand effect has been the most important factor in employment growth. All sectors, besides Mining (C), have experienced increases due to final demand increase. The most important increases have taken place in Electricity (E), Finance (J), Trade (G), Social services (O), and Transport (I), well over the average. The increase in final demand would have increased employment in Agriculture (A) and Fishing (B) as well, but this increase is not enough to compensate the other factors effect.

Tables 5 and 6 present SDA results applied to occupational employment change. The first shows the results when mid-points method is used. For each effect absolute and percentage employment variation is shown. Last column shows actual total variation. Table 6 shows the results with average polar decomposition method. For each effect we have appended the range between the two results. The differences among both tables, for the total employment variation and for any occupation are smaller than a percentage point.

Table 5. Occupational employment change. 2005-1995. Mid-points.

	Substitution effect		Productivity effect		Demand effect		Total Change
1	-128,88	-45,94%	-78,84	-28,10%	488,25	174,04%	281,73
2	174,34	19,59%	60,48	6,80%	655,12	73,61%	886,40
3	389,40	45,15%	-70,51	-8,17%	543,61	63,03%	855,95
4	-156,21	-51,63%	-132,80	-43,89%	591,58	195,52%	309,18
5	85,12	10,28%	-63,73	-7,70%	806,29	97,42%	827,30
6	-319,26	-47,93%	-331,25	-49,73%	1.316,63	197,66%	669,95
7	-108,91	-31,81%	-55,99	-16,35%	507,25	148,17%	343,95
8	64,47	8,84%	-81,02	-11,11%	745,67	102,27%	726,30
total	0,06	0,00%	-753,67	-15,38%	5.654,40	115,38%	4.900,75

Source: Own calculations.

Table 6. Occupational employment change, 2005-1995. Average Polar decompositions.

	Substitution effect		Range	Productivity effect		Range	Demand effect		Range
1	-127,69	-45,32%	-38,22	-80,03	-28,41%	-71,23	489,44	173,73%	109,44
2	170,80	19,27%	54,23	64,02	7,22%	15,75	651,58	73,51%	-69,98
3	382,85	44,73%	137,56	-63,96	-7,47%	-55,52	537,06	62,74%	-82,04
4	-149,60	-48,39%	-64,98	-139,42	-45,09%	-155,77	598,19	193,48%	220,74
5	84,74	10,24%	28,08	-63,36	-7,66%	-45,36	805,92	97,42%	17,27
6	-315,41	-47,08%	-32,07	-335,10	-50,02%	-179,40	1.320,48	197,10%	211,47
7	-107,31	-31,20%	-34,40	-57,59	-16,74%	-47,73	508,85	147,94%	82,13
8	61,66	8,49%	-50,20	-78,21	-10,77%	10,20	742,86	102,28%	40,00
total	0,05	0,00%	0,01	-753,65	-15,38%	-529,05	5.654,38	115,38%	529,04

Source: Own calculations.

Focusing on total employment change, only productivity effect and demand effect have been significant. Curiously, the substitution effect is almost nil for the aggregate. The employment growth attributable to demand effect would have been larger than actual figures. But the reduction in employment due to Productivity effect has compensated more than 15% of this increase. This reduction is due to the increase in total labour productivity.

These results are very different for single occupations. The substitution of workers within industries has favoured, in decreasing order, Technicians (3), Professionals (2), Service workers (5) and Elementary occupations (8). The percentage increases range from 45% for technicians to 8.5% for elementary occupations. At the same time, Clerks (4), Skilled (6), Managers (1) and Operators (7) have experienced employment reductions. The Productivity effect also shows different evolutions. The growth in total labour productivity has reduced employment in all occupations but Professionals (2). These reductions range from 50% in Skilled workers and 45% in Clerks to 7-8% in Technicians. The final demand growth has increased employment in all occupations, but it has been stronger in Skilled (6), Clerks (4), Managers (1), Operators (7) and Elementary occupations (8). In these categories, the estimated effect is larger than 100% and would have even doubled employment for Skilled workers. The smaller employment growth due to final demand is in Professionals (2) and Technicians (3).

One of our research questions has been to disentangle the causes behind the employment increase in occupations related with university degrees and vocational qualifications. That is, Professionals and technicians respectively. The most important factor behind employment increase has been the increase in final demand. But for this occupations, the effect is smaller than for the whole set. The substitution effect has appended a second important increase, larger in case of technicians. Reorganization of production has caused the substitution of other occupations by Professionals and Technicians. The employment variation attributable to productivity effect has worked different: while it has favoured professionals, increasing employment, it has penalised Technicians, causing an employment reduction. Both percentage changes are almost equal.

5. Conclusions

This study analyses the evolution of occupational and sectoral employment in Spain for the period 1995-2005. This has been a long and sustained growth period for Spanish Economy: average GDP growth has been larger than 3.5% and employment has grown more than 5 millions. For the analysed sectors, total employment growth was 4.9 million, an outstanding 43%. The process has changed sectoral and occupational employment structure.

Demand effect has been the main cause of sectoral employment shift. It has affected all sectors but Mining. It has been especially strong in Electricity, Finance, Trade, Social services and Transport. Technical change is the second effect beyond employment growth. This effect is related with changes in production processes, in organizational forms and with the incorporation of new processes and products. For 10 out of 14 sectors, it has increased employment. It has reduced employment in Finance. Labour requirements have reduced employment in 11 sectors: They employed 80% of total Labour force in 2005. This effect is related with direct labour productivity. It implies that the increase in productivity is significant to explain changes in sectoral employment structure. Only service sectors as Hotels, Real estate an Education have not experienced employment reductions due to Labour requirements.

The Occupational employment change has been broken down into three parts: Substitution effect, Productivity effect and Demand Effect. The first is the change on the sectoral occupational mix and the second is the change in direct plus indirect labour productivity. The main cause of occupational employment is demand effect. The productivity effect has reduced employment, offsetting part of the former increase. The substitution effect has been nil for the whole set of occupations. But, from a disaggregated point of view, Substitution effect has favoured Technicians, Professionals, Service workers and Elementary occupations. But it has also reduced skilled workers and operators employment. Productivity effect has reduced employment for all occupations but Professionals. The effect has been particularly strong for skilled workers, Clerks and Managers. The shifts in total labour productivity have been significant for the occupational employment structure.

The results obtained in this study point that Spanish Economy is strongly dependent of the final demand path. The recovery the economy and the increase in employment would depend on the evolution of final demand. The results show that other factors behind employment growth would hardly generate an employment increase. Moreover, we have seen that a large share in demand shift has been related with construction and related sectors. It is very difficult to expect this activity to undergo another demand increase: the growth in final demand has to come by other ways. Exports seem to be the alternative way to increase final demand.

Politicians and some analysts have argued that Labour Market Reform would make Spanish economy less dependent on demand shift. It is argued that reducing firing costs may increase the number of new jobs and that reducing workers' legal protection may conduct to a wage deflation that could increase Spanish competitiveness. This second effect could make other factors more reliable on employment growth. But, the labour reform may have another effect that we have not deal with. Our measure to

assess labour market performance has been employment: number of employed people. We have not bear with employment contracts. The large number of temporary employment contracts and the large turnover rates imply that, despite the employment figures increase, the social welfare may be not improving. Last but not least, the demand effect of the employment quality effects is generally underestimated. Less stable labour force imply less private consumption, a weaker final demand path that may feed back employment figures.

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Annex 1.

Table A1. Sectoral Classification

A	Agriculture, hunting and forestry	Agriculture
B	Fishing	Fishing
C	Mining and quarrying	Mining
D	Manufacturing	Manufacturing
E	Electricity, gas and water supply	Electricity
F	Construction	Construction
G	Wholesale and retail trade; repair of motor vehicles, motorcycles and personal and household goods	Trade
H	Hotels and restaurants	Hotels
I	Transport, storage and communication	Transport
J	Financial intermediation	Finance
K	Real estate, renting and business activities	Real estate
M	Education	Education
N	Health and social work	Health
O	Other community, social and personal service activities	Social services

Table A2. Occupational Classification

1	Legislators, senior officials and managers	Managers
2	Professionals	Professionals
3	Technicians and associate professionals	Technicians
4	Clerks	Clerks
5	Service workers and shop and market sales workers	Service workers
6	Skilled workers	Skilled
7	Plant and machine operators and assemblers	Operators
8	Elementary occupations	Elementary